Chapter 3: Affected Environment

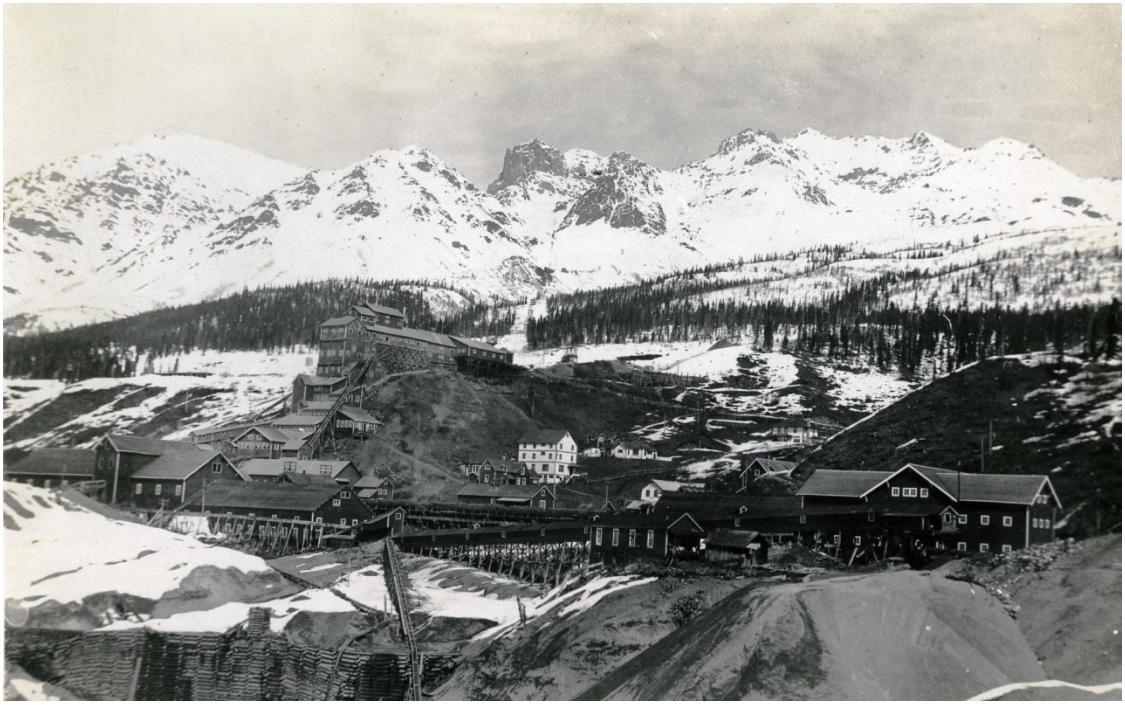
3.0 Introduction and Background

This chapter describes the existing environment that could be affected by implementing actions proposed by the alternatives. Impact topics identified in Chapter 1 are discussed.

Kennecott Mill Town, perched dramatically on a mountainside above the historic village of McCarthy and the Kennecott Glacier, is a vivid reminder of the rich resources and ambition that drew adventurous souls to the "last frontier" of Alaska a century ago. Kennecott is tucked away in a remote corner of Wrangell-St. Elias National Park and Preserve, the largest unit of the entire national park system.

The Kennecott mines and mill operated from 1901 to 1938, when their exceptionally high-grade copper veins were depleted. Approximately $200 million in copper ore was extracted during this relatively brief period, profits from which were used to capitalize mining ventures in other regions of North and South America. Kennecott Copper Corporation is still an important company on the international mining scene today. The remaining structures at the mill site and mines symbolize an ambitious time of exploration, perseverance, and development in Alaska's extreme environment and remote setting. In 1986, 14,231 acres of public and private land were designated a National Historic Landmark (NHL) District. In 1998, the National Park Service acquired 2,839 acres of land in the historic mill town, including its primary structures.

Photo 23: Kennecott, 1935



Listings in the National Register of Historic Places and National Historic Landmarks Program point out that Kennecott was one of the largest copper mines in the country and contained "the last of the great high-grade copper ore deposits of the American West" (NPS, 1978; NHLP, 2004). The mine and mill are representative of mining processes of their era. The camp or mill town still contains the powerhouse, tramway station, bunkhouses, and commissary, as well as the visually-dominant 14-story concentration

mill. Kennecott was also the site of the world's first successful, commercial-scale ammonia-leaching plant in 1916. This pioneering process greatly increased the amount of recoverable copper ore.

Kennecott's mines constituted one of the richest copper deposits in the world (Bundtzen, 1982). At the peak of production in 1916, the mines were producing 175 tons of crude ore per day, averaging 70 percent copper. When Kennecott was abandoned in 1938, total production of copper was over 590,000 tons; in addition, about nine million ounces of silver were produced as a byproduct. This constituted almost 86 percent of Alaska's copper production and almost half its silver production (U.S. Bureau of Mines, 1975).

The National Historic Landmarks Program noted in 2004 that threats or damages to the Kennecott NHL include deterioration of structures and lack of maintenance in the six decades between the time the mine and mill closed in 1938 until they were purchased by NPS in 1998 (NHLP, 2004). The principal mill-related industrial structures, buildings at the mine entrances, and the mines themselves all went without maintenance for half a century. A number of structures have reached the critical point where preservation is no longer possible. Still other structures are in better condition but have suffered damage from previous attempts at salvage of building materials and thus made more vulnerable to deterioration from the area's harsh climate. Increasing visitation to the NHL raises the risk that one or more buildings will eventually be destroyed by fire or vandalism.

3.1 Project Area

The project area is located approximately 310 miles east of Anchorage, Alaska, near the eastern terminus of the 60-mile McCarthy Road. It extends in a corridor for several miles west along the McCarthy Road from the Kennicott River out to the DNR firewise pavilion and several miles northeast along the McCarthy-Kennecott extension of that road up to and including the Kennecott Mines National Historic Landmark.

3.2 Water Resources

Because actions proposed in Chapter 2 of this EA have the most potential to affect Bonanza and National Creeks, they are the focus of this discussion. The following general information is also provided.

3.2.1 General Information

Two different types of rivers and streams flow in the McCarthy-Kennicott area. McCarthy Creek and the Kennicott River represent one type; they draw much of their water from melting glacier ice and carry a large load of silt and glacial rock flour as suspended sediment. The Kennicott River is a tributary to the Nizina River; the Nizina River is tributary to the Chitina River; the Chitina a tributary to the first order Copper River that flows into the marine waters of Prince William Sound. The other stream type consists of the clear water streams originating from springs. Examples of these are Swift Creek, Clear Creek, National Creek, Amazon Creek, Bonanza Creek and Jumbo Creek. These latter streams run clear year around except during heavy rains or the peak of spring snowmelt; turbidity and suspended sediments increase during extended or heavy rainfall, and during extended dry periods, surface flows diminish considerably. Drainage off Bonanza Ridge flows in a westerly direction, either as subsurface outwash or along the margin of Kennicott Glacier.

Fisheries: Glacial waters seldom have substantial resident fish populations, but they do provide migration routes from the ocean to spawning and wintering ground in clear water tributaries and lakes. Glacial streams generally have a higher gradient, higher sediment load, higher turbidity, and lower biotic productivity than non-glacial streams.

NPS inventory and monitoring efforts have found coho salmon, Dolly Varden, and slimy sculpen in the Nizina River; Dolly Varden in Clear Creek and in McCarthy Creek; and no fish in the Kennicott River, Jumbo Creek, Bonanza Creek, or National Creek (Markis et al., 2004).

3.2.2 National Creek

Mining History: National Creek lies in a steeply sloping valley, a tributary to the Kennicott Glacier valley and ultimately the Kennicott River. Historically, the stream played a very important role in the operation of the Kennecott mine and mill. Fundamental to the development of the site was a reliable supply of water for industrial and domestic consumption. By the end of 1910, workers had constructed a 150-foot-long crib dam made from local timber and located at the top of a small gorge above the manager's house. Located in close proximity to the camp, the dam stored drinking water and supplied water for a 250 horsepower hydroelectric plant constructed at the northern end of the mill town. A 1913 photo shows that the crib dam filled with sediment.

After construction of the concentration mill, water necessary for operating mill equipment came from two pipes. One led from the National Creek dam to the concentration tables while a second pipe channeled water from a point above the dam to the upper concentrator. National Creek ran through the center of the Administrative core of the milltown and during the period of peak mining operation (1915 – 1938) was flanked by several buildings, including Stephen Birch's house, the hospital, National Creek bunkhouse, the East bunkhouse, and the assay building.

Natural flood events have had a significant effect during the period when the mine operated and since the mine closing in 1938. Flood damage caused by the bursting of the National Creek dam in 1980, and again in 1983 and 2006, recontoured the central part of the mill town and deposited large volumes of silt through the National Creek bunkhouses, hospital, and assay building. The destruction of boardwalks and fire-hose casings in the National Creek area respectively eliminated indications of previously well-defined circulation patterns. West of the railroad trestle, flooding ruptured the tailing crib and deposited tailings farther down slope. In the process, waste removal systems exiting into National Creek (such as flumes and pipes) sustained major damage.

In an effort to minimize future flooding damage to historical structures, NPS in 2010 and 2011 did extensive work to the National Creek stream channel. Work consisted of removing gravel, sediment, and debris, straightening the channel away from structures, and lining the stream channel with large rock to return the stream to its original location. These actions will enhance channel function by decreasing avulsion, diverting flow away from the buildings and removing debris that was in the stream.

Geomorphology and hydrology: The headwaters of National Creek begin at 5,500 feet, and its confluence with the Kennicott Glacier is at about 1,750 feet above mean sea level (MSL). The average elevation of the basin is approximately 4,000 feet. The gradient in the vicinity of Kennecott is 8.6 percent. The total drainage area is approximately 2.2 square miles. National Creek is a tributary to the unnamed marginal melt water channel that parallels the Kennicott Glacier and then becomes the Kennicott River below the glacier's terminus (Hart Crowser, 2005).

The climate of Kennecott has elements of both coastal Alaska as well as the continental interior. It is neither as cold as the interior nor as wet as the coast. The mean annual precipitation is about 23 inches (Jones and Gass, 1993) and the average annual temperature in the region is slightly below freezing. March, April, and May are the driest months of the year, while September and October are the wettest, with an average of about 3 inches of precipitation in September. The hydrology of the National Creek watershed is dominated by snowmelt. Beginning usually in April, stream flow increases rapidly, with seasonal peak flow typically occurring in June; however, heavy rains in September are the typical cause

of the annual peak flow events. Low flow occurs October through March; data from the 1920s indicate that groundwater continues to supply flow to the stream during the winter months (Hart Crowser, 2005).

Water quantity and quality: There is ample stream flow from National Creek to use as a water source for hydroelectric or public water supply, depending on the quantity of water needed (Hart Crowser, 2005). The low flow period occurs in the winter, when there is generally less of a need for a public water supply, hydroelectric generation and in particular firefighting. The summer low flow occurs in late August, with September punctuated by storm flows. Overall, the mean annual flow was estimated in 2005 to be approximately 3.5 cfs (Hart Crowser, 2005). The low flow during the late 1920s was approximately 2 to 3 cfs.

Generally, there is a very high sediment load in National Creek. There are abundant sources of sediment that provide seasonal input. The total sediment contribution to National Creek was estimated at approximately 3,600 cubic yards per year per square mile, or about 4,000 tons/year (assuming 1.1 tons/cubic yard). For perspective, Reid and Dunne (1996) presented total sediment yield for various basins in the Pacific Northwest; they indicated a range of 31 to 335 tons/square mile/year (Reid, 1981).

Nearly all of the area clear-water streams, including National Creek, cross private property and are regularly used by residents for domestic water supplies. Concern whether geoenvironmental hazards related to the mines and mill exist at Kennecott was studied by Eppinger et al. (2000). Surface water samples from the Kennecott area had low metal concentrations. Although sediment, rock, and concentrate data indicated that high concentrations of potentially toxic elements such as arsenic, cadmium, copper, and mercury are found in mill and mine-waste piles, these metals are not mobilized because of the absence of acid-generating minerals in Kennecott-type deposits and the waste piles and mill tailing derived from them.

At Kennecott, surface waters are near neutral in pH and have relatively low conductivities (Eppinger et. Al., 2000). With respect to drinking water standards, none of the significant inorganic parameters listed by the Alaska Department of Environmental Conservation exceed established maximum contaminant levels. NPS water quality sampling specifically from National Creek confirm these findings. However, water sampling conducted in 2010 showed the presence of fecal coliform in water samples taken from National Creek.

3.2.3 Bonanza Creek

Mining History: Historically, a water intake was constructed at an elevation of 2350 feet on Bonanza Creek. The water was used for milling operations, power generation, fire protection, and drinking water. Water supply proved to be one of the most critical factors in operating the concentration mill facilities. The absence of enough water during the winter season required measures to conserve what was available. Improvements to the concentrator's water supply in 1917 (possibly by the installation of a cooling pond and water tanks to the northeast with which to recycle water) enabled the concentrator to run at full capacity for the first time. The power plant, requiring 100 gallons per minute of new water for cooling purposes, received water from both Bonanza Creek and from the concentrator's cooling pond. In spite of the supply improvements, both the concentration mill and power plant used water "over and over until it was practically worn out." (Gilbert et al., 2001)

Water Quantity and Quality: Bonanza Creek is a steep creek of repeating waterfalls and plunge pools originating in mountainous terrain with minimal glacial influence. The U.S. Geological Survey (U.S.G.S.) and National Park Service entered into a cooperative agreement in July 2006 to operate a hydrologic monitoring station on Bonanza Creek. Two gaging stations were installed and monitored for a five-year period. An upstream gaging station (15209750) was installed at the location of the historic Kennecott Mine hydroelectric plant water-intake site, about 3,000 feet east of the confluence with the

Kennicott Glacier, at 2,500 feet elevation. The second station (15209760) was established at the intersection of the Root Glacier trails and Bonanza Creek at about 1,950 feet elevation. The following table displays water quantity information measured at the two sites.

Table 3-1 Water Quantity Measurements at Bonanza Creek

WY	Date	Upstream (15209750)				Downstream (15209760)		
		Stage	Velocity	Area	Discharge	Velocity	Area	Discharge
		(ft.)	(ft.2/s)	(ft2)	(cfs)	(ft2/s)	(ft2)	(cfs)
2007	5/22/2007	6.04	0.72	5.94	4.29	0.94	1.92	1.83
	6/29/2007	6.02	0.80	6.46	5.22	0.79	3.24	2.60
	9/19/2007	6.10	1.28	7.00	9.02	1.48	3.39	5.05
2008	4/3/2008	5.76	0.25	3.05	0.77	-	-	0.30
	6/6/2008	6.10	1.21	7.56	9.20	1.49	3.75	5.62
	8/28/2008	6.06	0.91	5.11	4.69	1.35	2.76	3.74
	9/17/2008	6.03	0.78	4.40	3.45	0.95	2.57	2.46
2009	10/23/2008	5.95	2.12	3.62	2.12	1.42	1.74	1.42
	5/21/2009	6.14	1.37	6.43	8.83	2.61	3.72	9.74
	7/21/2009	5.98	0.63	5.11	3.23	0.72	4.72	3.61
	9/16/2009	5.91	0.80	4.35	3.49	0.86	1.94	1.66
2010	10/22/2009	5.91	0.85	4.19	3.57	0.89	2.02	1.80
	5/25/2010	6.11	1.53	7.23	11.0	2.16	3.63	7.85
	6/9/2010	6.08	0.96	7.22	6.90	1.76	2.38	4.19
	7/22/2010	6.11	1.33	9.55	12.7	2.36	3.95	9.33
	7/23/2010	6.12	1.35	9.09	12.3	2.14	4.08	8.75
	9/5/2010	5.94	0.76	5.32	4.05	1.05	1.95	2.05
2011	10/18/2010	5.88	0.55	4.28	2.34	0.58	1.47	0.80
	5/24/2011	6.05	0.88	6.65	5.90	1.38	2.82	3.88
	7/11/2011	6.02	0.80	5.52	4.41	1.03	2.71	2.80
2012	10/5/2011	5.89	0.59	4.50	2.68	0.5	2.02	1.01

Five water quality samples for suspended sediment analyses were collected, though only one had sufficient volume and sediment for a complete size analysis. Recent NPS water sampling in Bonanza Creek (2010) showed that, with respect to drinking water standards, none of the significant inorganic parameters listed by the Alaska Department of Environmental Conservation exceed established maximum contaminant levels. In addition, Bonanza Creek tested negative for fecal coliform.

3.3 Vegetation

History: During the years of active mining operations, site vegetation was managed by logging, hand clearing and grazing to maintain a more open condition, thereby resulting in views of structures within the town site proper and views of the Kennicott Glacier to the west. During the early years of town site development, trees and larger vegetation were logged for clearing and construction of mill and town-site improvements. Since 1938 establishment and natural regeneration of indigenous, non-native, and invasive species has occurred.

Remnant vegetation from early gardening can still be found within the site, including rhubarb, chives, and grasses. During the active mining years residents planted flower beds and vegetable gardens to supplement food imported to the mill town. Gardens in both community and individual cottage plots included: potatoes, cabbage, carrots, turnips, kale, radishes, strawberries and lettuce.

Vegetation description: The project area occurs in the McCarthy mountains subsection of the Wrangell Mountains ecoregion (NPS, 2001c). Vegetation in the valleys is mostly open white spruce (*Picea glauca)* or mixed spruce-birch forest. Some closed deciduous mid-to tall shrubs are present, especially on valley side slopes. High elevations have mostly exposed rock, talus, and scree with little vegetation. More stable lower slopes and valley bottoms have deciduous shrubs that generally increase in height in density downslope. Some white spruce forests occur at low elevations. Unvegetated or sparse shrubs and herbs occur in active floodplains. Less disturbed floodplains have deciduous shrubs or cottonwood (*Populus balsamifera)* trees, and later successional stages have white spruce forest.

Before the Kennecott mill site was developed in the early 1900's, repeated natural disturbances (e.g., advancing glaciers, floods, and fire) resulted in vegetation that was successional and supported four primary plant communities (Gilbert et al., 2001). These communities were:

- Seral herbs located along the moraine of Kennicott glacier with scattered and newly established fireweed (*Epilobium angustifolium),* dryas (*Dryas drummondii),* soapberry (*Sheperdia Canadensis),* and willow (*Salix spp.)* seedlings.
- Open white spruce forest with cottonwood, paper birch, and an understory of willow and alder.
- Closed white spruce forest on upper slopes, with paper birch as an associate and an understory of willow and alder (*Alnus crispa).*
- Open tall alder-willow shrub riparian zone along National Creek with barren areas from repeated flooding.

Today a white spruce-hardwood forest with alder, willow, poplar, and mixed herbaceous plants dominates existing vegetation at the mill site (Gilbert et al., 2001). Virtually all of the land cleared during the mining era has revegetated. The lower elevations of Bonanza Ridge are forested. Further up the ridge, at tree line, the trees give way to shrubs and herbaceous vegetation. The ridge top is in the alpine zone. A spruce beetle outbreak that began in 1990 has killed many mature spruce trees. White spruce communities comprise 33% of the Kennecott Mill site, shrub communities comprise 41%, and the remaining 26% cover is herbaceous (NPS, 2000a).

Higher elevations above tree line in the study area support sub-alpine and alpine plant communities. As the upper elevational limit of trees is approached, spruce forest becomes more open and there is a higher cover of tundra shrubs. In the southern Wrangell mountains, shrub tundra and meadows within it contain a group of species generally absent in northern regions of the park. This trend is particularly evident in lush meadow areas where the vegetation is often dominated by species with coastal affinities such as *Arnica latifolia, Erigeron peregrinus, Carex nigricans, Heracleum lanatum, Juncus mertensianus, Luetkea pectinata, Senecio traingularis, Vahlodea atropurpurea,* and *Valeriana sitchensis* (NPS, 2005b).

Snowbed areas and north-facing slopes in the alpine zone are characterized by a high cover of heaths (principally *Cassiope tetragona*), mountain avens *(Dryas alaskensis*), polar willow (*Salix Polaris)* and netted willow (*S. reticulate)* with a characteristic assemblage of common forbs including *Antennaria monocephala),* spring beauty (*Claytonia sarmentosa),* mountain sorrel *(Oxyria digyna), Polyganum viviparum,* and buttercups *(Ranunculus eschscholtzii)* (NPS, 2005b). Club moss (*Huperzia selago)* and the grasses *Hierochloe alpine* and *Trisetum spicatum* are also common on snowbed sites. A small group of species is noticeably more abundant in snowbed sites in the southern Wrangell Mountains as compared to northern regions of the park. *Luetkea pectinata*, *Potentilla diversifolia* and *Sibbaldia procumbens,* for example, are abundant in the south and west parts of the park and uncommon or absent in the north and east. Dry sites from the sub-alpine to alpine zone support a range of plant communities from discontinuous graminoid-forb associations to continuous dryas-graminoid-forb tundra depending on slope, aspect, substrate and slope morphology. Xeric alpine plant communities harbor numerous rare and endemic plant species. Endemic species that occur in dry sites throughout alpine areas of the park include *Astragalus nutzotinensis, Erigeron purpuratus, Saxifraga reflexa* and *Senecio ogoturukensis.*

The entire NHL has not been surveyed for rare plants. Six Alaska Natural Heritage Program listed rare plants have been documented for Bonanza Ridge (Table 3-2) and 41 rare plant species that are known to occur in the Chitina valley (available in Gilbert et al., 2001) may also be found in the McCarthy-Kennecott area.

Table 3-2. Rare plants documented for Bonanza Ridge

Common Name	Scientific Name	AKNHP Rank
Aleutian cress	*Aphragmus eschscholzianus*	G3/S3
Presl's sedge	*Carex preslii*	G4/S1
Mountain fragile fern	*Cystopteris montana*	G5/S3
Creeping savin	*Juniperus horizontalis*	G5/S1S2
Mountain stitchwort	*Minuartia biflora*	G5/S2
Pale poppy	*Papaver alboroseum*	G3/S3

AKNHP = Alaska Natural Heritage Program
G = global rank
S = State rank
G1 = critically imperiled globally (5 occurrences or fewer)
G2 = imperiled globally (6 – 20 occurrences)
G3 = either very rare and local throughout its range or found locally in a restricted range, threatened throughout its range.
G4 = widespread and apparently secure globally, although it may be rare in parts of its range
G5 = demonstrably secure globally, although it may be rare in parts of its range
S1 = critically imperiled in the state, 5 or fewer occurrences
S2 = imperiled in the state, 6 – 20 occurrences
S3 = rare or uncommon in the state, 21 – 100 occurrences

Exotic Species and Invasive Weeds: For the purpose of this discussion, native and exotic species are defined per the 2006 NPS Management Policies (NPS 2006). Native species are defined as all species that have occurred, now occur, or may occur as a result of natural processes on lands designated as units of the National Park System. Native species in a place are evolving in concert with each other. Exotic species are those species that occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Exotic species are also commonly referred to as nonnative, alien, or invasive species. Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component of the natural ecosystem at that place. Genetically modified organisms exist solely due to human activities and therefore are managed as exotic species in parks. Not all exotic species are detrimental to habitat quality or biodiversity; however, they are of concern because they can threaten the genetic integrity of native flora through hybridization, typically flourish in disturbed areas resulting in the exclusion of native vegetation, and can change the structure and function of ecosystems through alterations of geochemical and geophysical processes (McKee 2003). The term "noxious weed" is used when referring to an exotic species that has been officially designated by a federal, state, or county government as injurious to the public health, agriculture, recreation, wildlife habitat, or the biodiversity of native habitats.

The NPS has conducted surveys for exotic and invasive species in Alaska's parklands since 2000 (Bauder and Hays 2004). Since this time, they have documented 38 exotic plant species occurring within the park (Terwilliger and Gilmore, 2010). Of these 38 species, 29 have been documented within a 5-mile radius of the Kennecott mill site. Table 3-3 displays the invasive species that have been documented within this area. The Alaska Exotic Plant Information Clearinghouse (AKEPIC) rank is used to determine the invasive ability and veracity of an exotic plant species. The ranks range from 0 to 100, with 100 representing the highest level of invasive ability. Species without a rank are generally new enough to the state that their invasiveness has not been quantified.

Table 3-3 Exotic Plant Species Documented within the Analysis Area

Scientific Name	Common Name	Area of infestation (acres)	AKEPIC Rank
Bromus inermis	Smooth brome	0.358	62
Capsella pastoris	Shepard's purse	2.061	40
Caragana aborscens	Siberian peashrub	0.029	66
Cerastium fontanum	Mouse-ear chickweed	6.162	36
Chenopodium album	Lambsquarter	1.863	37
Crepis tectorum	Narrowleaf hawksbeard	2.645	54
Descuriana sophia	Tansymustard	0.353	41
Elymus repens	Quackgrass	0.0001	59
Galeopsis tetrahit	Hempnettle	0.004	40
Hordeum jubatum	Foxtail barley	8.396	63
Lappula squarrosa	European stickweed	1.671	44
Lepidium densiflorum	Common pepperweed	2.91	25
Leucanthemum vulgare	Oxeye daisy	0.006	61
Linaria vulgaris	Yellow toadflax	0.011	69
Matricaria discoidea	Pineappleweed	2.709	32
Papaver nudicaule	Icelandic poppy	0.007	NA
Phleum pratense	Common timothy	0.583	54
Plantago major	Common plantain	2.166	44
Polygonum aviculare	Prostrate knotweed	0.604	NA
Polygonum convolvulus	Black bindweed	0.003	50
Rumex crispus	Curly dock	0.007	48
Silene noctiflora	Nightflower campion	0.078	42
Stellaria media	Common chickweed	0.006	42
Taraxacum officinale	Common dandelion	127.362	58
Thlaspi arvense	Filed pennycress	0.295	NA
Trifolium hybridum	Alsike clover	22.144	57
Trifolium pratense	Red clover	0.043	53
Trifolium repens	White clover	1.196	59
Veronica serpyllifolia	Thymeleaf speedwell	0.149	NA

The NPS conducts annual inventory and control efforts within the NHL. In 2011, work was performed on several species growing around cottages on Silk Stocking Row. This area had previously been disturbed by construction and remodeling of the cottages. Lambsquarter, common dandelion, prostrate knotweed, various clovers, pineapple weed, tansymustard, common chickweed, mouse-ear chickweed, and oxeye daisy were inventoried and controlled. The WRST Exotic Plant Management Team (EPMT) and SAGA crews also focused on control work around the Recreation Hall, the Company Store, and the General Managers Office. One large (> 1 acre) infestation near the office contains 12 species of invasive plants. South of the General Managers Office near the National Creek Bridge, Kentucky bluegrass was documented for the first time by the WRST EPMT. The infestation was mapped and controlled.

3.4 Cultural Resources

The historic significance of the Kennecott Mine and Mill Town are described in Section 1.5 under the section labeled "**Kennecott Mines National Historic Landmark".** Cultural resources include: historic properties as defined in the National Historic Preservation Act (NHPA), cultural items as defined in the Native American Graves Protection and Repatriation Act (NAGPRA), and archeological resources as defined in the Archeological Resources Protection Act (ARPA).

As defined by the NHPA, a historic property or historic resource is any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places (NRHP), including any artifacts, records, and remains that are related to and located in such properties. As defined by ARPA, archeological resources include any materials of human life or activities that are at least 100 years old, and that are of archeological interest.

Section 106 of the NHPA provides the framework for Federal review and consideration of cultural resources during Federal project planning and execution. The implementing regulations for the Section 106 process (36 CFR Part 800) have been promulgated by the Advisory Council on Historic Preservation (ACHP). The Secretary of the Interior maintains the NRHP and sets forth significance criteria (36 CFR Part 60) for inclusion in the register. Cultural resources may be considered "historic properties" for the purpose of consideration by a Federal undertaking if they meet NRHP criteria. Historic properties are those that are formally placed in the NRHP by the Secretary of the Interior, and those that meet the criteria and are determined eligible for inclusion.

Those properties on the NRHP that possess exceptional value in illustrating the nation's heritage can be designated by the Secretary of the Interior as a National Historic Landmark. Only 3% of properties listed in the NRHP are designated as National Historic Landmarks. Section 800.10 of ACHP regulations, as well as Section 11(f) of the NHPA, offer protection from a Federal undertaking which may directly and adversely affect any National Historic Landmark. In addition, once a property is designated as a National Historic Landmark, the NPS commits to assist in the preservation of these irreplaceable properties through the National Historic Landmarks Assistance Initiative. The Assistance Initiative promotes the preservation of National Historic Landmarks through technical assistance to their stewards—owners, managers, and friends groups—and education of the general public about the importance of National Historic Landmarks. The NPS works with partners such as other federal agencies, state governments, local governments, colleges, private organizations and individuals, and nonprofit organizations to educate and assist the public in preserving its historic heritage (NPS, 2003c).

In 1986, 14,231 acres of public and private land at Kennecott were designated a National Historic Landmark District. While NHL and National Register status are often a source of pride for landowners and the community, they grant no protection to the resources from the actions and development decisions of private landowners. The acquisition by NPS of 2,839 acres in the historic mill town within the NHL in 1998, including most of the mill town's primary structures, was a major step forward on behalf of Kennecott's preservation.

The Kennecott NHL faces a number of challenges related to its long-term preservation. Many of the historic structures are in need of stabilization to prevent their collapse or gradual deterioration and disintegration from decades of exposure to the harsh forces of nature in the area.

3.4.1 Cultural Landscapes

Cultural landscapes are broadly classified as geographic areas that include both natural and cultural resources, and the wildlife or domestic animals therein that are associated with a historical event, activity, or person, or that exhibit either cultural or aesthetic values.

At Kennecott, as in all mining ventures, the occurrence and utilization of natural resources as well as broader landforms and topography helped shape the development and operation of the mines and mill. From the early exploration and discovery of high-grade copper ore on Bonanza ridge to the eventual siting of infrastructure, processing facilities and related services at the moraine on the edge of the Kennicott Glacier, the nature of the landscape heavily influenced the configuration and functional relationships of the mill town's components (Gilbert et al., 2001). Vegetation clearing, the location of the copper ore and mines above the mill site, the steep terrain, the presence of the Kennicott Glacier, and the

presence of Bonanza and National creeks, exploited for hydroelectric power and water, respectively, all affected development of the Kennecott cultural landscape. This landscape was intensively inventoried by NPS in its 2001 *Cultural Landscape Report.*

Outside the NHL, the historic town of McCarthy, associated with Kennecott almost from the very beginning, would represent an undesignated cultural landscape. The existence and location of the town at the foot of the mountain, near the confluence of Kennicott River and McCarthy Creek, and its close proximity to the mill town are a function of both the natural landscape and historical, social and economic factors. The road from McCarthy to Kennecott, following the old railroad bed, and the old wagon road between McCarthy-Kennecott would also have features of cultural landscapes.

3.4.2 Archeological Resources

Archeology is the study of physical evidence left behind by past generations, both prehistoric and historic, and later discovered on the ground, under the ground, and underwater.

At the time of the first contact with Europeans, what is now Wrangell-St. Elias National Park was occupied primarily by Athapaskan Indians, in particular the Ahtna of the Copper River drainage. When the Athapaskan Indians arrived in the area is not well known, but they may have been present for more than a thousand years (NPS 1986). Numerous sites representing the later Athapaskan tradition, dating to about 800 BP, have been documented along the western boundary of the national park and preserve. Major excavations have been conducted at Dakah De'nin's Village, a site situated along the Copper River near Chitina, dated from the prehistoric period. Directly across the river, at Taral, investigations have revealed an historic period occupation (NPS, no date-b). To date, no significant prehistoric archeological resources have been identified in the Kennecott-McCarthy area.

Within the NHL, archeological features help define the character of Kennecott (NPS, 2000a). Archeological resources in the NHL include collapsed buildings, pipelines, large industrial artifacts (e.g. mining equipment, remnant cable, and machinery), dumps, and equipment storage piles. Most of these are considered significant because of their association with historic activities at Kennecott during 1900 – 1938. Other later features that are not considered significant are not managed as cultural resources. Approximately 70% of the mill town's surviving archeological resources are considered to be in stable condition, that is, having reached an equilibrium with the processes of deterioration and erosion. Stable resources would include large metal objects; wooden features like collapsed buildings tend not to be in stable condition.

Outside the NHL, an archeological survey along the McCarthy road conducted by the Alaska Office of History and Archeology identified significant historic resources, most associated with the Copper River and Northwestern Railway, including trestles, railway remains, remnants of old homesteads and artifact scatters (NPS, 2002). Archeological-cultural surveys by WRST staff at the proposed McCarthy walk-in campground and the West Side support complex did not identify any significant resources at either site (NPS, 2003a).

3.4.3 Historic Structures and Buildings

Within the NHL, historic structures include boardwalks, dams, bridges, tram towers, and landscape features such as tailings piles. Many of these structures are made of wood and are continually deteriorating (NPS, 2000a). A failed dam on National Creek and subsequent flood events have caused flood damage to the National Creek bunkhouse, railroad trestle, and the assay building.

The NHL includes 45 major residential, commercial, and industrial historic buildings, 25 outbuildings, and the four upper mountain mine sites. Twenty-three buildings have been acquired by NPS. All of them

are built of wood and have survived more than 60 years of abandonment and neglect; their condition ranges from poor to fair (NPS, 2000a).

Outside the NHL, McCarthy contains a number of historic buildings and some historic structures like the switching station.

3.4.4 Cultural Objects, Museum Collections and Archives

Kennecott artifacts include cultural objects and archival materials. Cultural objects are items like tools, domestic items, remnants of larger features, wooden pipes, equipment, and machinery parts (NPS, 2000a). The objects, made of both metal and wood, are scattered throughout the landscape but may also be found in buildings, dumps, and equipment storage piles. The metallic objects are considered stable but the wooden objects continue to be subject to erosion and weathering-related deterioration.

Archival materials consist of forms, receipts, and other paper documents, usually found in buildings. These materials have been collected over the decades both by collectors and through combined efforts of the University of Alaska, NPS, and the McCarthy Museum. Uncollected archival materials remaining in the mill town tend to be in poor condition (NPS, 2000a).

3.5 Wildlife

Wrangell-St. Elias National Park and Preserve contains one of the largest protected ecosystems in North America, and supports numerous populations of wildlife species. Wildlife management in the preserve is a cooperative effort among the National Park Service and the Alaska Department of Fish and Game (NPS, 2004a). The study area is situated in the preserve in Game Management Unit 11; notable wildlife species are brown (grizzly) bear, black bear, moose, lynx, and red fox (NPS, 2000a). Caribou do not typically occur in the project area; the three caribou herds that use portions of the park and preserve are found north of the Wrangell Mountains (NPS, 2004a). Dall sheep are present at higher elevations, and are not typically found in areas where proposed actions would occur. Other wildlife species in the area include snowshoe hare, red squirrel, porcupine, ermine (short-tailed weasel), northern red-backed vole, meadow vole, and the little brown bat (NPS, 2000a).

Two passerine migratory routes pass through the park and there are records for 239 species of birds with approximately 53 species listed as residents (NPS, 2005c). Common birds in the McCarthy-Kennecott area include the great horned owl, northern goshawk, spruce grouse, northern raven, and black-billed magpie. Other passerine birds that can be seen in the area are the gray jay, dark-eyed junco, yellow-rumped warbler, orange-crowned warbler, black-capped chickadee, American robin, Swainson's thrush, ruby-crowned kinglet, alder flycatcher, and common redpoll (NPS, 2000a).

Encounters between humans and bears (both black and brown) have been common in the McCarthy-Kennecott area for many years. In 2000 and 2001, the NPS conducted a bear study to quantify the nature of these encounters and describe the resident bear population (Wilder, 2003). A human-bear conflict is defined as any instance where human food, garbage, or other attractants bring bears into close proximity with humans; where bear opportunistically receive food rewards from human encounters; where property is damaged; where bears are killed or wounded; or any encounter where bears display aggressive behavior toward humans. Food and food odors are bear attractants; unsecured attractants can increase the number of human-bear conflicts.

Data indicate that at least 26, and possibly as many as 36, bears were killed during the years 1999 to 2001 (Wilder, 2003). In 2000-2001, there were 157 reports of bear-human conflicts, although this is likely an underestimate, as many incidents go unreported. The most common reason for conflicts was human food, and bears received a food reward in 37% of reported incidents. In the cases where the human party in the

conflict was identified as either a local resident or park visitor, local residents were involved in 80% of reported human-bear conflicts. A dangerous situation currently exists in the area due to the high number of food conditioned bears and lack of basic services for local residents.

Soapberry *(Sheperdia Canadensis)* occurs on recent glacial moraines in very extensive stands. The fruit are relatively high in protein and energy and is easily digestible. In the fall bears seek out the most productive and nutritious food sources available. The ripening of soapberry draws bears to the McCarthy-Kennecott area.

Based on the NPS bear study (Wilder, 2003), current knowledge and research regarding human-bear conflicts in the McCarthy-Kennicott area indicate that:

- The number of resident humans in the area, the number of humans visiting the area, the amount of road and trail access, the amount of off-road and off-trail travel, and the occurrence and sanitation of human development are positively correlated with the frequency of human-bear conflicts.
- Bears are common in the McCarthy-Kennicott area.
- Natural food sources for bears are abundant.
- Soapberries are an important food resource for bears in the area, and may influence the occurrence of human-bear conflicts.
- Past human-bear conflicts in the area have involved many bears rather than a few "problem" bears.
- High-quality food sources and increased human presence increase habituation of bears to humans.
- Unsecured attractants are a major cause of human-bear conflicts, and maintain the presence of food-conditioned bears.
- Bears habituated to humans and conditioned to human foods are responsible for the majority of recorded human injuries arising from human-bear conflicts.
- Defensive actions (shooting of bears) associated with human-bear conflicts would increase direct and indirect injury and mortality for black and brown (grizzly) bears.

3.6 Visual Resources

Wrangell-St. Elias National Park and Preserve has some of the most spectacular scenery and visual resources anywhere in North America. While the Wrangell Mountains in the project vicinity are not as lofty as in other parts of the park, the McCarthy-Kennicott gateway community is still known for its outstanding views of rugged Alaskan wilderness, including glaciers, snow-capped mountains, rivers, and extensive boreal forests.

Within the NHL, visual resources include a historic component, that is, the view of aging, individual, historic buildings and structures in various states of deterioration, and more holistically, the appearance of the historic mill town in its entirety. In recent decades, unmanaged vegetation, especially trees and shrubs, have encroached upon and obstructed many historic views (Gilbert et al., 2001). Also, certain newer, non-historic structures and land uses within the NHL may not be entirely consistent with the desired appearance and character of the Kennecott Mill Town, or may impinge upon important viewsheds. An example is the existing NPS materials lay down/storage area near the Dairy Barn, in which supplies and tarp(s) covering them can be visually prominent or obtrusive.

3.7 Visitor Use and Experience

The NPS Organic Act calls for the national park system and NPS, "to provide for the enjoyment of the resources in such manner and by such means as will leave them unimpaired for the enjoyment of future generations". WRST has two mission goals that follow from this broad statutory mandate:

Mission Goal IIa: *Visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities.*

Enjoyment of national parks is a fundamental aspect of the visitor experience. Visitor enjoyment and safety are affected by the quality of park programs, facilities, and services, whether provided by the NPS, a concessioner, or a contractor. Availability of park facilities, services, and recreational opportunities refers to convenient locations and times of operation that fit visitors' transportation and schedule needs (NPS, 2000b).

Mission Goal IIb: *Park visitors and the general public understand and appreciate the preservation of parks and their resources for this and future generations.*

Visitors' park experiences grow from enjoying the park to understanding why it exists and the significance of its resources. Satisfactory visitor experiences build public support for preserving this country's heritage as contained in the national parks (NPS, 2000b).

Additionally, WRST strives to meet the management concepts developed jointly by the community of Kennicott/McCarthy and the NPS. Relative to visitor use and experience, the following apply:

- *Kennecott is stabilized to prevent deterioration of historic structures or artifacts and to make them available to the public, to the greatest extent possible in accordance with public safety.*
- *Kennecott is not just an abandoned mining town, but also a place that reflects the vitality, creativity, and community spirit of today's residents.*
- *Kennecott/McCarthy retains the slow pace, quiet, and spaciousness that foster contemplation and individual reflection. In particular, NPS will encourage visitors to enjoy the NHL as pedestrians, and will seek to minimize the impact of management activities (including, but not limited to, noise and visual impact) on both visitors and local residents alike.*
- *Kennecott/McCarthy is a place where tourism is allowed to evolve within the capacity of the community, rather than a place where external intervention and control accelerate growth.*
- *Kennecott/McCarthy is seen by local residents and visitors alike in its true context: a remote outpost of civilization in the midst of an enormous mountain wilderness.*

3.7.1 Visitation

Total visitation at WRST is on the rise. Recreation visits to the park grew from 40,352 in 2002 to approximately 60,000 in 2,011. The Kennecott District is the most heavily visited area of the park. NPS estimates current visitation to the McCarthy/Kennecott area to be about 12,000 visitors annually. Visiting McCarthy-Kennecott was the third most popular reason for visiting the park, and walking around Kennecott mine site was the third most popular visitor activity. Furthermore, the most popular backcountry in WRST is the backcountry surrounding the McCarthy-Kennecott area. Most park visitation takes place between June and September, and visitors come to the Kennecott District by road or air.

The University of Alaska (Fairbanks) conducted a study of Kennecott on-site visitation in 2004. They divided visitors into the following categories: Outdoor Enthusiast, Park Experience, History Buff, General Visitor, and Tourist Visitor. Each is described fully in the *Visitor Preferences for Interpretation in the Kennecott Mill Town, Final Report (*Taylor, 2005*).* The report also identified several important characteristics of NHL visitors:

- Most visitors stay on average 2 – 3 days and are interested in a variety of activities.
- Most arrive by vehicle and over 75% are visiting for the first time.
- Nearly half are 50 years old or older, and nearly 80% have at least a bachelor's degree from college.
- Over 60% were traveling in family groups.
- Further structure stabilization, exploring the outside of more town buildings, the addition of signs and exhibits, and a film explaining historical significance all ranked fairly high on the "add to visitor experience" end of the scale.

3.7.2 Existing Visitor Facilities

At present, the area still offers limited facilities and services to accommodate the use and contribute to the enjoyment and education of Kennecott-McCarthy visitors. There is no welcome sign for visitors arriving at the McCarthy-Kennecott area, but NPS has installed a sculptural metal sign just inside the southern boundary of the NHL that announces the landmark. While some visitor facilities are provided, information on services and activities can be hard to find. Lack of readily available information about land ownership patterns can sometimes result in visitors accidently trespassing on private lands. A McCarthy Road Information Station—with interpretive and informational media—is located a mile west of the Kennicott River footbridge, but it is set back from the road where it is inconspicuous, and it does not have sufficient staffing. While maps and other information are available at the McCarthy Road Information Station, the facilities provide inadequate wayfinding. There are private businesses in the vicinity of the McCarthy Road Information Station that provide information to the visitor, but it is focused on private tour opportunities.

Private parking is provided for visitors (for a fee) on the west side of the Kennicott River. From there, a visitor can shuttle gear across the footbridge and wait for a privately operated shuttle bus to travel the six miles to Kennecott. It would be easy for visitors who have not been to the site before or who have not done some pre-planning to be confused. Visitor lodging is limited but provided by private establishments in McCarthy and Kennecott.

Just inside the NHL boundary, the NPS has constructed a shuttle bus turnaround in compliance with a previous public planning process. Partially completed in 2009, the stop contains an area for shuttle buses to drop off visitors and turn around, a sculptural metal sign that announces the landmark, and one kiosk/shelter with four exhibit panels. A local business, Wrangell Mountain Air, provides the shuttle buses, and St. Elias Alpine Guides, a park concessionaire, provides the coordination for visitors to be dropped off. The shuttle buses, however, do not use the shuttle stop, but drop passengers in front of a private business. Visitors, as a result, miss the gateway orientation and end up confused as to the location of NPS services, other local businesses, the identify of buildings, and what is NPS or private property.

The following is description of the current NPS visitor services in Kennecott:

- Recreation Hall: Restored historical building, opened to the public in 2003. There is a box with WRST maps outside the entrance at the head of the stairs. Inside and available for interpretive or community programs, there is a film screen and projector; the building has a 200-person capacity. NPS is currently working on a lease agreement in cooperation with a local non-profit to manage the building for community and special events. Two exhibit panels by NPS and Friends of Kennicott provide information.
- Refrigeration Plant: Opened to the public in 2008; no current exhibits.
- General Store/Visitor Center: Opened to the public in 2008 as a visitor center. It has an exterior box with WRST maps. The right half of the store is a re-creation of the General Store using a 1917 inventory and includes 822 objects (mostly reproduced cans with scanned labels) and 378

historic objects. These objects were installed in 2010. The General Store also contains exhibits on wildlflowers, bear safety, maps, ore display, historical photos, aerial view of the glacier, and leave no trace. Alaska Geographic Association sales take up about one quarter of the store.

- Power Plant: Top level mezzanine/viewing was opened to the public in 2006; inside tour by concessions. Accessible ramp installed in 2006. One exhibit panel on the mezzanine installed in 2006.
- General Manager's Office: The oldest structure in Kennecott, opened to the public in 2009. Five historic photographs and one contemporary photo on the main level in three rooms.
- Kennecott Cottage 39C, Lot 88: Opened to the public in 2006; one exhibit panel installed in 2007.
- Train Depot: Opened to the public in 2004. Used as a visitor center until 2007. One exhibit panel outside the front door produced in 2010.
- Concentration mill: Concession tours only. Three, two-hour tours offered per day.

While the Kennecott mill town retains much of its historic, rustic character and charm, ongoing stabilization and rehabilitation activities may interfere with visitor enjoyment of individual structures and buildings. Some of the structures are off-limits to general visitors for safety reasons or are being used for storage. In addition, some non-historic, non-compatible more recent development detracts from the overall historic character of the site.

Several public toilets are available in the McCarthy-Kennecott area: two at the McCarthy Road Information Station, two at the second footbridge, one at the "Y" by the Museum, one at McCarthy airport, one by the Company Store, two at the Recreation Hall, and one trail pit toilet at the Jumbo Creek camping area.

3.8 Transportation and Access

3.8.1 General

The main transportation route in the area is along the McCarthy Road, which reaches its eastern terminus on the west bank of the Kennicott River at about MP 60. A state-built footbridge provides access for pedestrians further east. There is no access for the general public with vehicles to cross the river at this point. Approximately ¼ mile downstream of the footbridge is a vehicular bridge constructed on private land. Bridge passes are available from a local business, by trip or season for a fee. NPS and some local businesses utilize this bridge to haul freight to McCarthy or Kennecott.

On the east side of the footbridge, the one-lane, unpaved McCarthy Road continues, bypassing downtown McCarthy and continuing for about four miles up to the Kennecott Mill Town, following the original railroad alignment. This road is used by automobiles, shuttle vans, off-road vehicles, motorcycles, bicycles, and pedestrians. It generally lacks well-developed wide spots to allow vehicles to pass and on busier days this can lead to congestion. ADOT&PF and local businesses maintain the road from the footbridge to the NHL boundary. An historic, unpaved wagon road provides an alternative route for hikers, bikers, and pedestrians from McCarthy to Kennecott.

The McCarthy road, state right-of-way ends at the entrance of the Kennicott Subdivision, about 1 mile south of the NPS "Kennecott Mines National Historic Landmark" sign at the shuttle turnaround. The roads within the Kennecott subdivision are easements across private and public (NPS managed) lands. The legal description of these roads is found on the subdivision plat which was recorded with the State recorder's office in 1977. This plat states "the rights-of-way as shown or noted are private, reserved for the use of the present owners of lots in this subdivision and their guests." Neither individual Kennicott

Subdivision lot owners nor the NPS have authority to unilaterally impose restrictions on the use of the Kennecott Subdivision easements, for transportation purposes, by the other lot owners and their guests.

The majority of the landowners in Kennecott have requested of WRST that, as the rights-of-way cross their private land, their property rights as specified by the plat be respected. The have also raised with WRST liability concerns regarding use of motorized vehicles by the general public on the Kennecott rights-of-way, as those vehicles pose a hazard to pedestrians on steep and narrow roads with reduced visibility. The residents have specifically requested that the park notify non-local visitors to the NHL that they are welcome to use the rights-of-way on foot or bicycle, but that ORV, motorcycle, and motor vehicle use by the general public within the subdivision is not allowed. The Kennicott Subdivision landowners have communicated to local residents within the greater McCarthy/Kennecott area that they are guests of the subdivision residents. This informal message regarding motor vehicle use within the Kennecott Subdivision does not apply to area residents.

3.8.2 Parking

West of the Kennicott River there are 8 – 10 free day parking spaces are available at the NPS McCarthy Road Information Station, and there are several privately owned, fee based overnight parking lots, including one at the footbridge. The State and the NPS have recognized that parking and loading/unloading at the footbridge presents logistical issues for the general public and area landowners. Past efforts to secure public lands for parking near the foot bridge have been unsuccessful.

East of the Kennicott River, informal, unmarked parking spaces for up to about 15 vehicles used to be available at the footbridge on the State right-of-way and private property; however, in 2005 this space was eliminated and now the site can only be used for loading and unloading supplies and passengers from vehicles.

Within the NHL, motorists now park vehicles along the rail corridor adjacent to the Kennicott Glacier Lodge (within a subdivision easement), at the shuttle bus turnaround, and along the lower glacier road behind the Recreation Hall in an uncontrolled fashion.

Besides walking and bicycling, several privately operated van shuttles are the principle method for visitors to reach McCarthy or the NHL from the Kennicott River. These shuttles do not usually operate early or late in the day, and are not generally able to readily accommodate wheelchairs or transport bicycles. If specifically requested by customers, shuttles can make early or late runs.

3.8.3 Off Road Vehicle Use

Local residents use Off Road Vehicles (ORVs) for a variety of purposes, including as a commuter vehicle, hauling material, or in pursuit of subsistence resources (berry picking, hunting). ORV use by visitors has become more commonplace since the installation of the footbridge across the Kennicott River. Although designed for pedestrian use only, bollards blocking ORV traffic on the footbridge were removed by local residents and have not been replaced.

Visitor use of ORVs to access Kennecott (or points beyond, such as the Bonanza mine) is problematic for several reasons:

- Legally, ORVs cannot be driven on the McCarthy road (state right-of-way). Alaska Statute 28.10.011 requires all motor vehicles driving "upon a highway or other public parking place" shall be registered. However, ORVs do not comply with Federal Department of Transportation standards for tires and rims. No ORV on the market today meets federal emission standards since no manufacturer has applied for such. Therefore, they are deemed unsafe for road use and

cannot be registered as motor vehicles. (Language directly from a brochure titled "Alaska's ATV Law", written and distributed by the Alaska State Troopers).

- Legally, ORVs cannot be driven across the Kennicott River foot bridge. Alaska Statute 13 AAC 02.455(f) state no snowmobile or other off highway vehicle may cross or travel on a sidewalk, a location intended for pedestrian or other non-motorized traffic, an alley, or a vehicular way or area which is not open to snowmobile or off-highway vehicle operation. The Kennicott River foot bridge was built with funds appropriated specifically for pedestrian access.
- Kennecott subdivision easements (which are unavoidable to a motorized Kennecott visitor) are private and reserved for the use of the present owners of lots in the subdivision and their guests.
- Recreational ORV use (including to access sport hunting in the national preserve) requires a permit in Wrangell-St. Elias National Park and Preserve, issued under 43 CFR 36.11(g)(2) which allows superintendents to issue permits for ORVs on existing ORV trails, upon determining that such use is compatible with park purposes. NPS has made no such determinations for the trails in and around Kennecott/McCarthy.

3.9 Soundscape

According to the NPS, the acoustical environment is comprised of a combination of acoustic resources, including natural, cultural, and historical sounds. A soundscape is defined as the way in which humans perceive this acoustic environment. Specifically, the natural soundscape encompass all of the natural sounds that occur in parks, including the physical capacity for transmitting those natural sounds and the interrelationships among park natural sounds of different frequencies and volumes (NPS 2006). Natural sounds may vary from bird calls and insect hums, to sounds produced by physical processes like wind rushing through leaves on trees, thunder, and rushing and falling water through rivers, creeks and streams within a park. According to the NPS, 72% of visitors indicate that a crucial reason for the need to preserve national parks is that parks provide opportunities to experience natural peace and the sound of nature (NPS, 2009g). Therefore, the NPS works to preserve, to the greatest extent possible, the natural soundscapes of parks.

3.9.1 Human Response to Changes in Noise Levels

Noise may have adverse effects on the human population in a variety of ways. Noise may interfere with human activities, such as sleep, speech communication, and tasks requiring concentration or coordination. At a physiological level, noise may also cause annoyance, hearing damage, and other health-related problems. The degree of disturbance from unwanted sound depends essentially on 1) the amount and nature of the intruding noise; and 2) the type of activity occurring where the noise is heard. In considering the first of these factors, it is important to note that individuals have different sensitivity to noise. Loud noise bother some people more than others, and some patterns of noise also affect a person's perception of whether or not a noise is offensive. With regard to the second factor, individuals tend to judge the annoyance of noise relative to the natural sounds (i.e., without the intruding noise source) and activities occurring where the noise is heard. For example, if regions of a park are dedicated to enjoying the tranquility and serenity of the natural environment, sounds from motor boating or Off Road Vehicles might be distracting to the visitor experience. However, if these activities are consistent with the purpose of a particular region of a park, these sounds would be considered appropriate. Therefore, noise is a subjective term, and it is important to characterize the activities essential to the park's purpose. Activities associated with stabilization of historic structures in a National Historic Landmark would certainly seem to be activities essential to the NHL's purpose.

3.9.2 Noise Fundamentals

According to NPS, "although noise has been used as a synonym for sound, it is essentially the negative evaluation of sound by people, is extraneous, or undesired. Humans perceive sound as an auditory sensation created by pressure variations that move through a medium such as water or air and is measured in terms of amplitude and frequency" (NPS, 2009g). The magnitude of noise is usually described by its sound pressure. Since the range of sound pressure varies greatly, a logarithmic scale is used to relate sound pressures to some common reference level, usually the decibel (dB). Sound pressures described in decibels are called sound pressure levels and are often defined in terms of frequency-weighted scales (A, B, C, or D).

The A-weighted decibel scale is commonly used to describe noise levels because it reflects the frequency range to which the human ear is most sensitive (1,000 – 5,000 Hertz). Sound levels measured using an A-weighted decibel scale are generally expressed as dBA. Throughout this section, all noise levels are expressed in dBA. Several examples of sound pressure levels in the A-weighted (dBA) scale are listed in table 3-4.

Table 3-4. Example of Common Sounds

A-weighted Sound Level (dBA)	Overall Level	Noise Environment
120	Uncomfortably loud (32 times as loud as 70 dBA)	Military jet airplane takeoff at 50 feet
100	Very loud (8 times as loud as 70 dBA)	Jet flyover at 1,000 feet Locomotive pass-by at 100 feet
80	Loud (2 times as loud as 70 dBA)	Propeller plane flyover at 1,000 feet. Diesel truck 40 mph at 50 feet.
70	Moderately loud	Freeway at 50 feet from pavement edge at 10:00 a.m. Vacuum cleaner (indoor)
60	Relatively quiet (one-half as loud as 70 dBA)	Air condition unit at 100 feet. Dishwasher at 10 feet (indoor)
50	Quiet (1/4 as loud as 70 dBA)	Large transformers Small private office (indoors)
40	Very quiet (1/8 as loud as 70 dBA)	Bird calls. Lowest limit of urban ambient sound
10	Extremely quiet	Just audible ($1/64^{th}$ as loud as 70 dBA)
0	Threshold of hearing	Quietest sound detectable by a healthy human ear

3.9.3 Existing Sound Levels (Kennecott mill town)

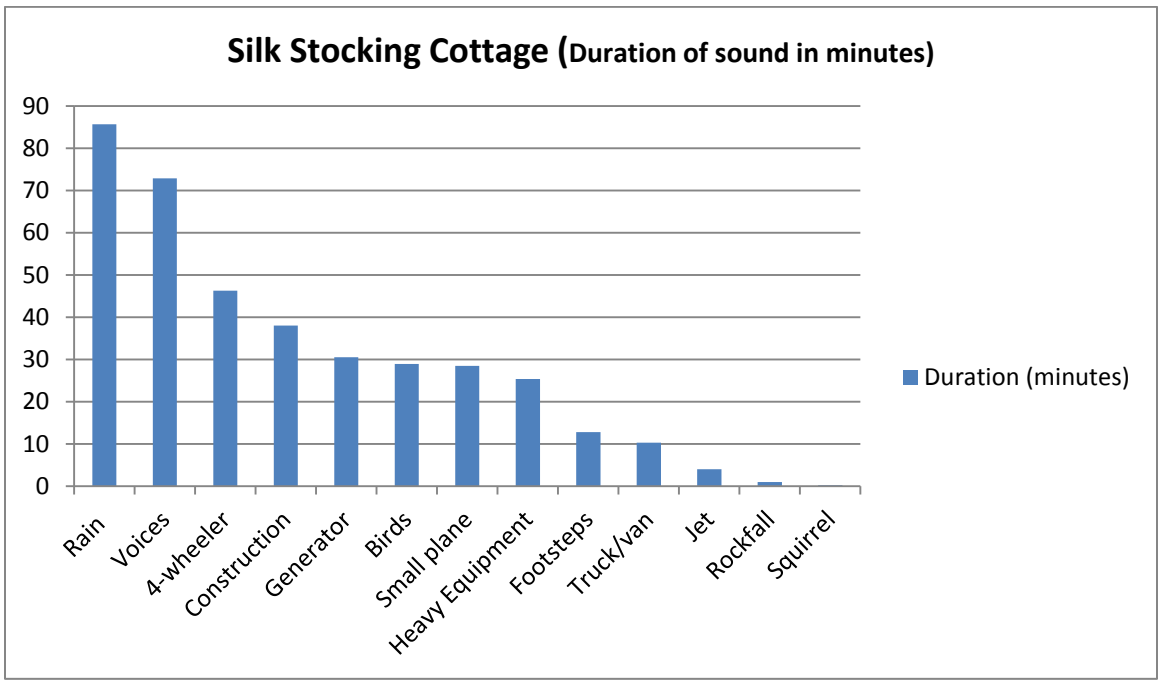
The Kennecott mill town at the peak of the mine's production was a noisy place. The processing of the copper ore through the concentration mill; engines, turbines and boilers in the power plant; and transport of ore via railcar through the middle of the mill town made for a noisy environment. Work shifts went on 24 hours a day, seven days a week. Upon her arrival to Kennecott in 1937, Ethel LeCount, a nurse at the hospital, noted "the rumble of the mill and the tramline; the rattle of 'high grade' going down the chute to the sacking shed" as an introduction to her stay in Kennecott.

Kennecott is now a different place. Visitors come to see and learn about the history of the site but also to experience the wilderness setting outside of the mill town. Kennecott residents value the opportunity to live in a remote setting and enjoy natural sounds and quiet.

May through September are busy and sometimes noisy months in Kennecott mill town. NPS is in the process of doing major stabilization and restoration work on several historic structures throughout the milltown. Noise associated with stabilization work varies but can include general construction noise

(power tools, hammering, yelling); heavy equipment such as the park's backhoe/front-end loader; work trucks or 4-wheelers; and the constant hum of the park's generator. Larger or more complex restoration/stabilization work requires the use of contractors, sometimes involving heavy equipment (such as dump trucks) or specialized equipment (jack hammers or drill rigs). The noise associated with NPS stabilization efforts generally starts early in the morning (0630 or 0700) with the morning 4-wheeler "commute", and tapers off at 1700 or 1730. Overtime or contract work sometimes occurs on weekends.

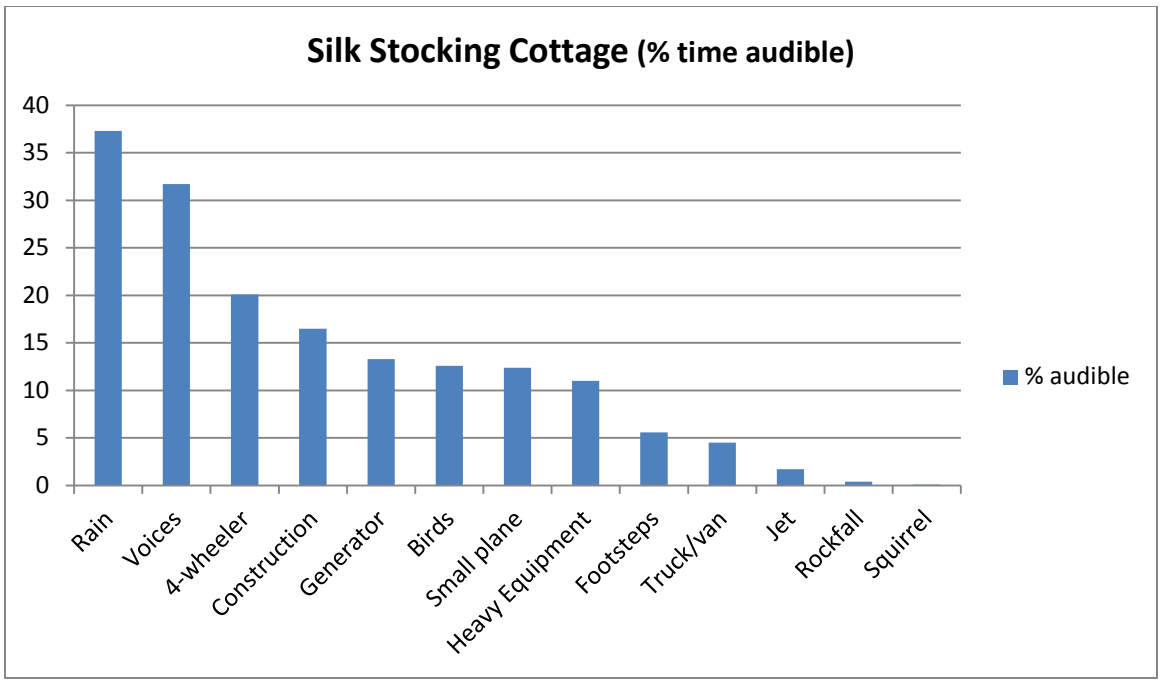
In an effort to characterize the sounds in and around the Kennecott millsite, NPS personnel conducted a series of "sound logging" sessions between August 22, 2012 and August 26, 2012. Duration of each session was generally 2 hours, with 2-2 hour sessions done at each location. Locations included: 1) Front porch of a Silk Stocking cottage; 2) Outside the General Manager's Office; 3) at the Shuttle Turnaround; and 4) just north of the mill town on the Root Glacier trail. The following graphs display the sounds recorded at each location. For each sound logging location, the sounds recorded are characterized according to the overall level described in Table 3-4.



Silk Stocking sounds were characterized as follows:

- Rain: Not a hard rain, but steady. Quiet (50 dBA).
- Voices: Varied between Quiet (50 dBA) and Relatively Quiet (60 dBA).
- 4-wheeler: Ranged from Quiet (50 dBA) to Moderately loud (70 dBA) depending on proximity.
- Construction: Source was work being done on the pumphouse behind the cottage. Moderately loud (70 dBA) because of close proximity.
- Generator: Very quiet (40 dBA) and obscured by other sounds.
- Birds: Very quiet (40 dBA) and obscured by other sounds.
- Small plane: Ranged from Quiet (50 dBA) to Loud (80 dBA) depending on proximity.
- Heavy equipment: The park's backhoe working in close proximity. Loud (80 dBA).
- Footsteps: Quiet (50 dBA).
- Truck/van: Ranged from Quiet (50 dBA) to Moderately loud (70 dBA) depending on proximity.

- Jet: Ranged from Quiet (50 dBA) to Moderately loud (70 dBA) depending on proximity.
- Rockfall: Glacier rockfall. Very quiet (40 dBA) and obscured by other sounds).
- Squirrel: Quiet (50 dBA).



The second set of sound logging sessions was taken at the General Manager's office on August 24, 2012. Two separate sessions were logged (from 1100 – 1300 and 1500 – 1645). The sounds shown in the graphs below (page 83) are characterized as follows:

- Water flow: The sound of National Creek. Relatively quiet (60 dBA).
- Voices: Varied between Quiet (50 dBA) and Relatively quiet (60 dBA).
- Construction: Power tools, sawing, hammering. Moderately loud (70 dBA).
- 4-wheeler: Ranged from Quiet (50 dBA) to Moderately loud (70 dBA), depending on proximity.
- Small plane: Ranged from Quiet (50 dBA) to Loud (80 dBA) depending on proximity.
- Helicopter: Operating out of McCarthy airport. Not flying directly overhead. Moderately loud (70 dBA) to Loud (80 dBA).
- Bird: Very quiet (40 dBA).
- Heavy Equipment: The park's backhoe, at a distance. Relatively quiet (60 dBA) to Moderately loud (70 dBA).
- Footsteps: Footsteps or sounds associated with bicycles. Quiet (50 dBA).

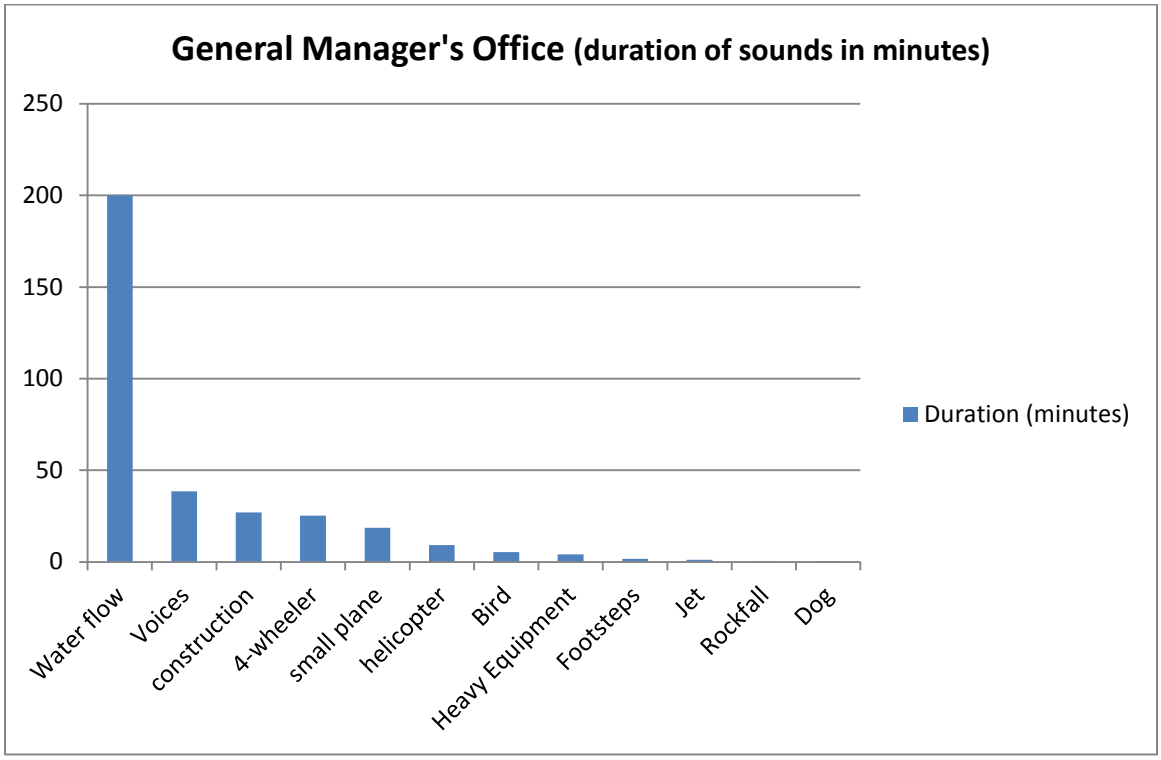
- Jet: Quiet (50 dBA) to loud (80 dBA) depending on proximity.
- Rockfall: Quiet (50 dBA).
- Dog: From a distance. Quiet (50 dBA).

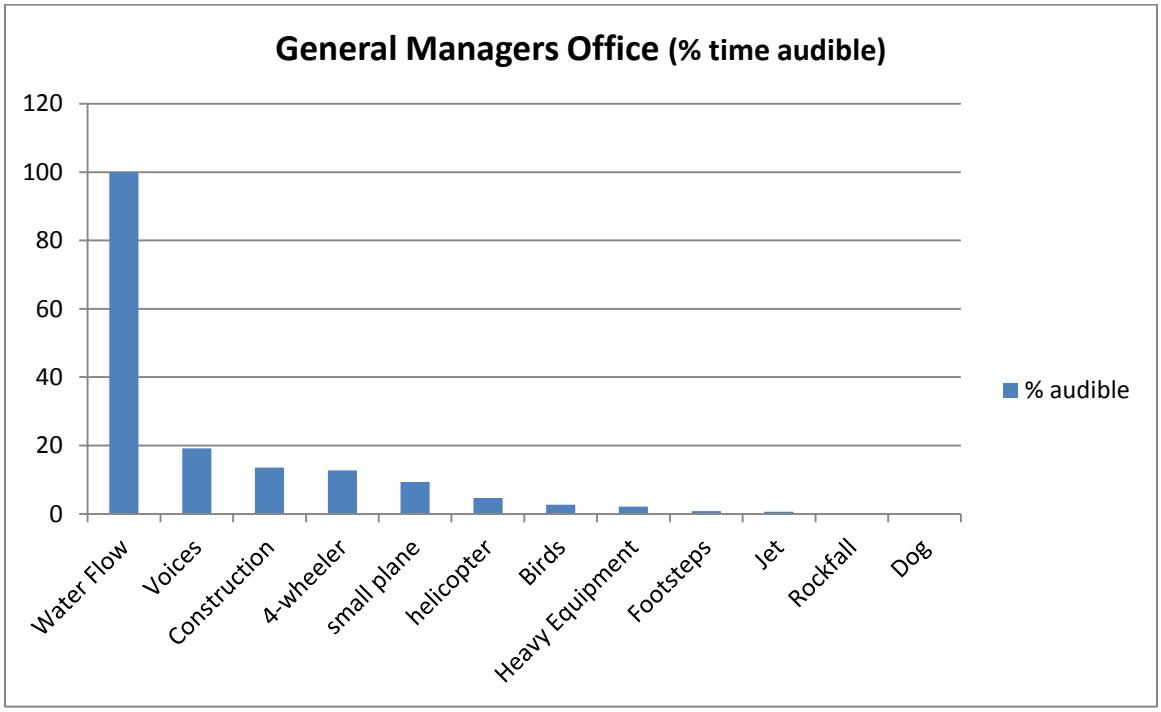
The third set of sound logging sessions was taken at the Shuttle Turnaround on August 25, 2012. Two separate sessions were logged (from 0845 – 1030 and 1600 – 1815). Some of the sounds shown in the graphs below (page 84) can be characterized as follows:

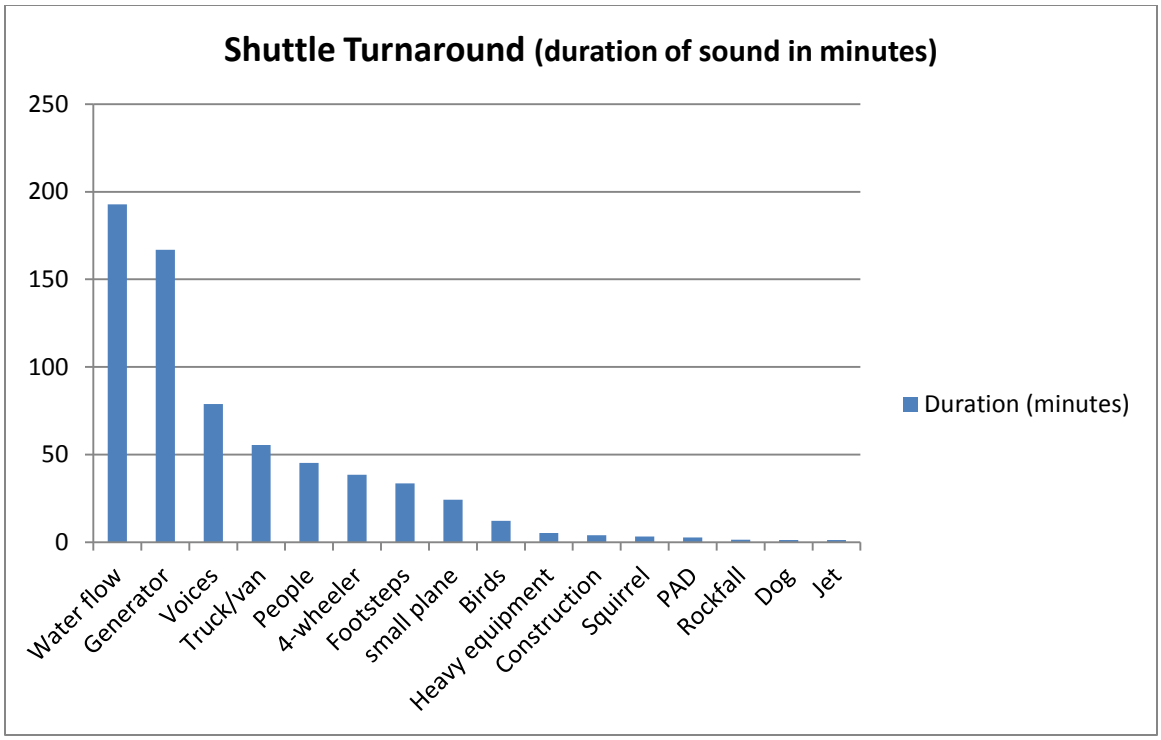
- Water flow: National Creek. Quiet (50 dBA).
- Generator: The NPS generator, a steady background noise at this location, but obscured by other noises. Relatively Quiet (60 dBA).
- Voices: Relatively Quiet (60 dBA).
- Truck/van: A dominant sound at this location. Relatively quiet (60 dBA) to Moderately loud (70 dBA) depending on proximity.
- People: Sounds associated with people, other than voices and footsteps, such as doors opening or closing. Relatively quiet (60 dBA).
- 4-wheeler: Ranged from Quiet (50 dBA) to Moderately loud (70 dBA), depending on proximity.
- Footsteps: Footsteps or sounds associated with bicycles. Quiet (50 dBA).
- Small plane: Ranged from Quiet (50 dBA) to Loud (80 dBA) depending on proximity.
- Birds: Very quiet (40 dBA).
- Heavy Equipment: NPS backhoe at a distance. Relatively Quiet (60 dBA).

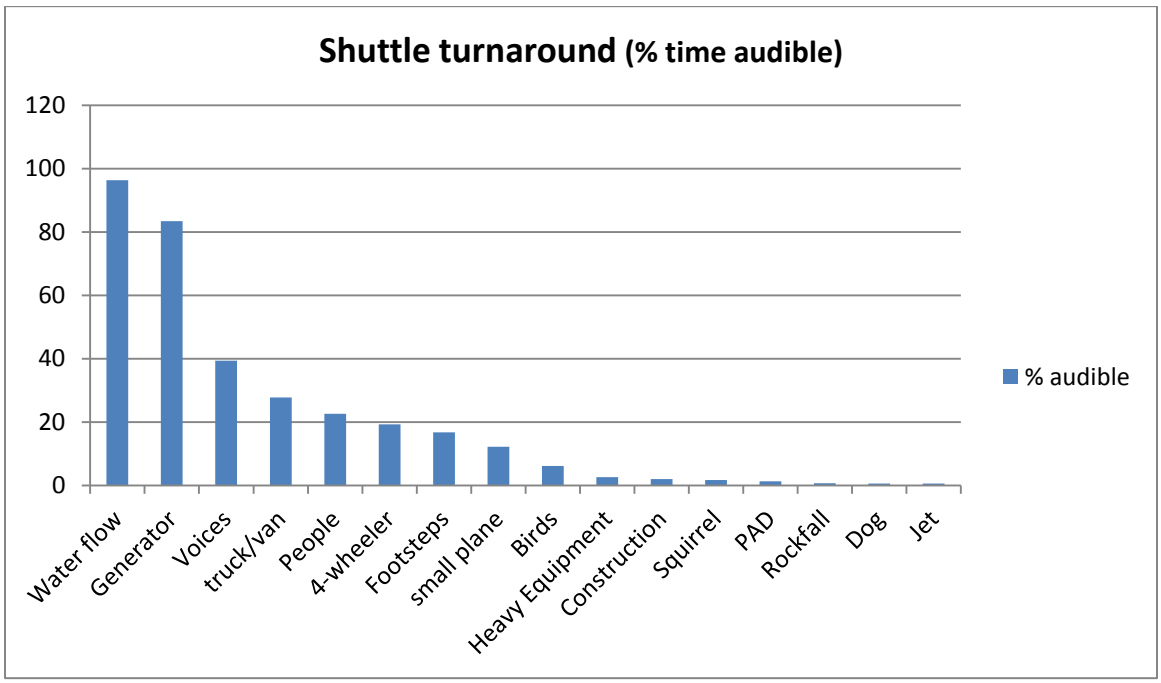
The fourth sound logging session was taken along the Root Glacier trail approximately 100 yards from the last cottage. One session was logged on August 27, 2012 from 1000 to 1230. Some of the sounds shown in the graphs below (page 85) can be characterized as follows:

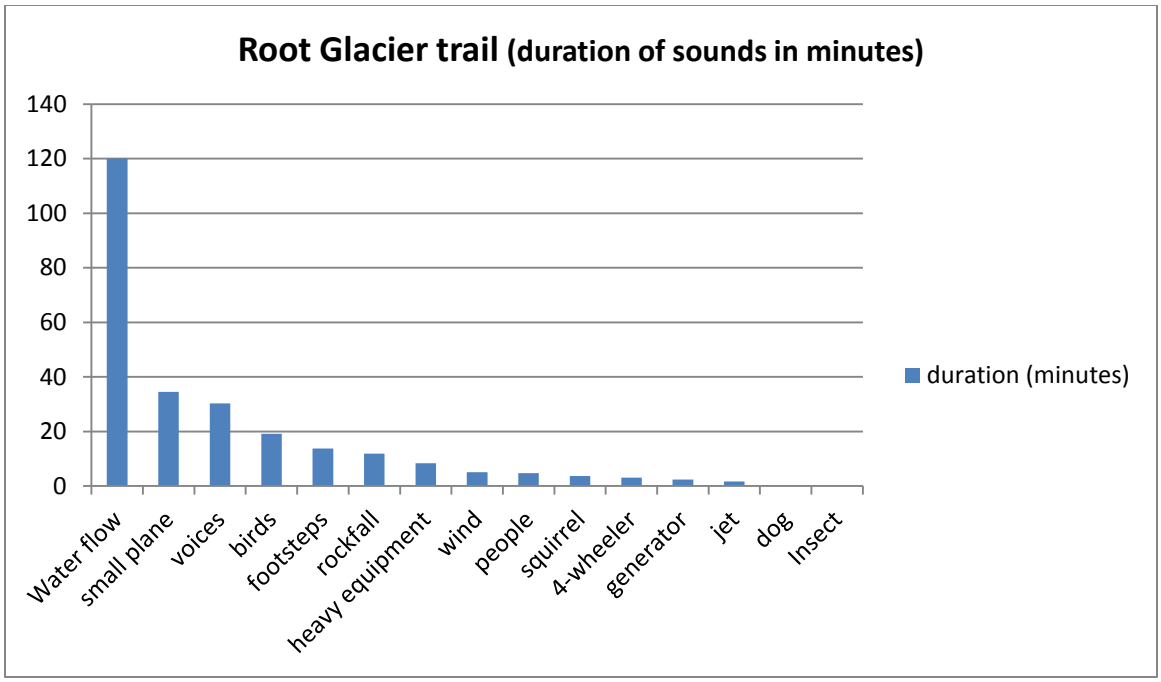
- Water flow: Dominant sound at this location but not loud enough to obscure other sounds. Quiet (50 dBA).
- Small plane: Ranged from Quiet (50 dBA) to Loud (80 dBA) depending on proximity.
- Birds: Very quiet (40 dBA).
- Voices: Very Quiet (40 dBA) to Quiet (50 dBA) depending on proximity.
- Footsteps: Very Quiet (40 dBA) to Quiet (50 dBA) depending on proximity.
- Rockfall: Quiet (50 dBA).
- Heavy Equipment: NPS backhoe at Dairy Barn. Could barely hear the back-up alarm. Very Quiet (40 dBA).
- Wind: Quiet (50 dBA).
- 4-wheelers: Quiet (50 dBA) to Relatively Quiet (60 dBA) depending on proximity.
- Generator: Local generator (not NPS), easily obscured by other sounds. Very Quiet (40 dBA).

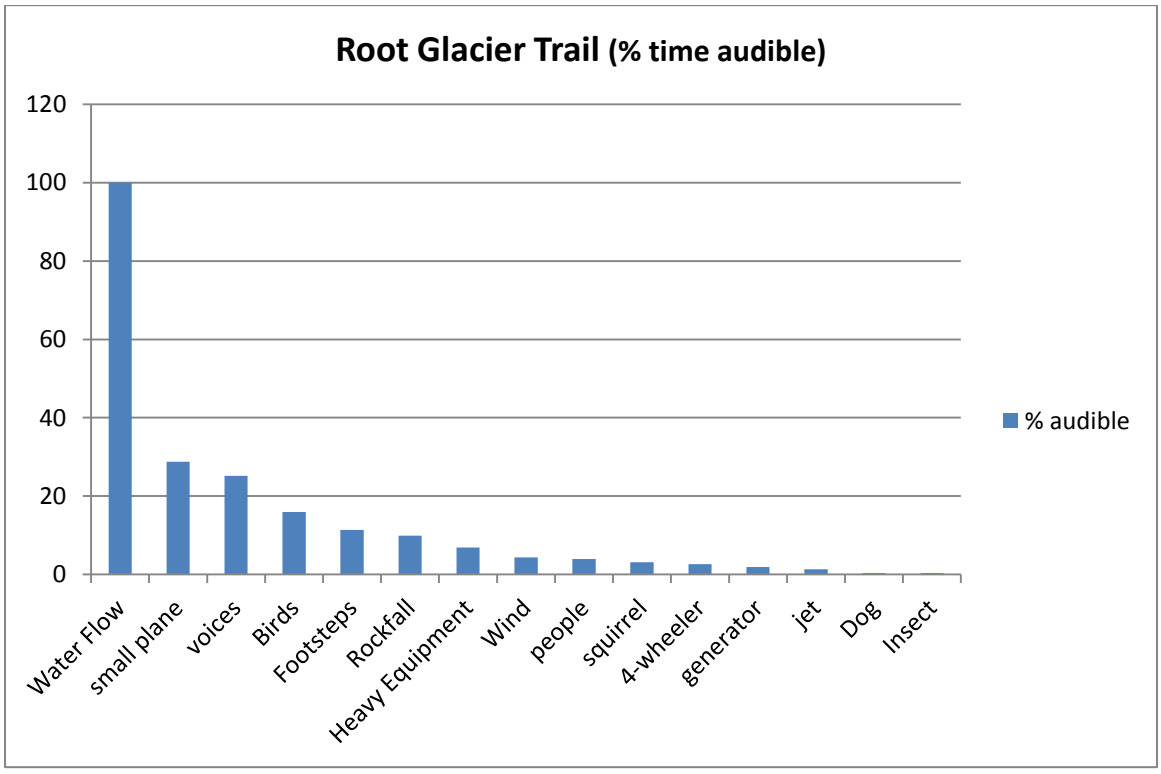

General Manager's Office (duration of sounds in minutes)
250
200
150
100
50
0
Water flow
Voices
construction
4-wheeler
small plane
helicopter
Bird
Heavy Equipment
Footsteps
Jet
Rockfall
Dog
Duration (minutes)


General Managers Office (% time audible)
120
100
80
60
40
20
0
Water Flow
Voices
Construction
4-wheeler
small plane
helicopter
Birds
Heavy Equipment
Footsteps
Jet
Rockfall
Dog
% audible


Shuttle Turnaround (duration of sound in minutes)
250
200
150
100
50
0
Water flow
Generator
Voices
Truck/van
People
4-wheeler
Footsteps
small plane
Birds
Heavy equipment
Construction
Squirrel
PAD
Rockfall
Dog
Jet
Duration (minutes)


Shuttle turnaround (% time audible)
120
100
80
60
40
20
0
Water flow
Generator
Voices
truck/van
People
4-wheeler
Footsteps
small plane
Birds
Heavy Equipment
Construction
Squirrel
PAD
Rockfall
Dog
Jet
% audible


Root Glacier trail (duration of sounds in minutes)
140
120
100
80
60
40
20
0
Water flow
small plane
voices
birds
footsteps
rockfall
heavy equipment
wind
people
squirrel
4-wheeler
generator
jet
dog
Insect
duration (minutes)


Root Glacier Trail (% time audible)
120
100
80
60
40
20
0
Water Flow
small plane
voices
Birds
Footsteps
Rockfall
Heavy Equipment
Wind
people
squirrel
4-wheeler
generator
jet
Dog
Insect
% audible

3.9.4 Conclusions from sound logging data

Sound logging data represents a "snapshot in time" although the sessions were taken over a 4-day period. The conclusions drawn below are based only on the data presented above with the full realization that impacts to soundscape could be different dependent on the scale of NPS stabilization work occurring at the time. Based on review of the sound logging data, the following observations were made:

- During weekday "business hours" in the milltown, the soundscape is dominated by "non-natural" sounds.
- At the one site just outside of the milltown (Glacier Trail), natural sounds such as water flow or wind provided the background, broken occasionally by non-natural sounds.
- While impossible to accurately quantify, sounds that can be attributed to NPS activities account for less than ½ of the non-natural sounds; other sounds are associated with visitors or locals.
- Of the sounds attributed directly to NPS activities (Construction, Generator, Heavy Equipment, and 4-wheelers), those that are audible the most (% time audible) are Generator and 4-wheelers. This suggests that some mitigation aimed at decreasing the volume or duration of these sounds could go a long way at decreasing impacts.

3.10 Socioeconomics

In 1990, Joseph Sax characterized the McCarthy/Kennicott area as follows: "It was no doubt inevitable that change would come even to this solitary and isolated place. Beginning in the later 1950's, a few people rediscovered the area, not for its minerals but for its breathtaking natural setting and for the ever-rarer opportunity it offered to live, not a primitive existence, but a life apart from contemporary rhythm and pace. There is no more stunning mountain and glacier backdrop above a river valley anywhere in the world. Bear and moose are still casual visitors in the streets of McCarthy, and Dall's sheep are nearby. Gradually the population grew to the present few dozen, most of whom still do not spend the full winters there. There are also a few weekend-only residents who make the long trek from Anchorage as often as they can. Some new houses have been built, and a number of the original buildings have been restored." (Sax, 1990).

Things have changed in 25 years, but this is still a good characterization of the community and the reasons people live there. The 2010 Census Demographic Profile for McCarthy Census Designated Place lists the population at 28 (USCB, 2010). The Census lists a total of 74 "housing units", with 20 occupied and 53 for "seasonal, recreational, or occasional use".

Full-time and seasonal residents of the area support their lifestyles in a variety of ways, including summertime businesses (guides, flying services, lodging, arts, contracting, mining) and subsistence activities. In the winter season, many seasonal residents go to Anchorage or elsewhere for employment opportunities. NPS hires a number of local residents as rangers, interpreters, or on the maintenance crew for historic structure stabilization in Kennecott. In 2011, NPS hired 20 seasonal workers on the maintenance crew and paid approximately $575,000 in seasonal wages.

Business activity in the area peaks in the summer. Local businesses include 2 air taxi services, 3 guiding and/or rafting businesses, one arts and crafts shop, several lodges and B&Bs (some of which provide food service), a bar, a grocery store, and a diner. There is also a local contractor and freighting service.

Installation of a private bridge across the Kennicott River had a major socioeconomic effect on the community. The bridge is privately owned but available for use for a fee. This provides easier community access to freighting of goods and services, including building materials, food services, groceries, septic services, fuel, and a host of other items.